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(54) Disk drive reducing speed indicator

(57) A disk drive assembly for a computer comprises a housing 21 with an aperture 22 for a hard disk drive unit 23, the drive unit incorporating a casing, a hard disk and read/write heads, the casing and aperture having associated interengaging connectors 24, 25, and the assembly including a control system for the disk drive with means for switching the drive on and off and a disk speed display 29 responsive to switching off the drive and such as to display an indication of reducing speed of the disk until the disk comes to rest whereby an operator is warned not to remove the hand disk drive unit immediately after switching off. Display 29 may be a row of lamps, or a dial or digital display for example. A speed senson responsive to actual speed reduction or preferably a timer such as an R-C circuit may be employed.

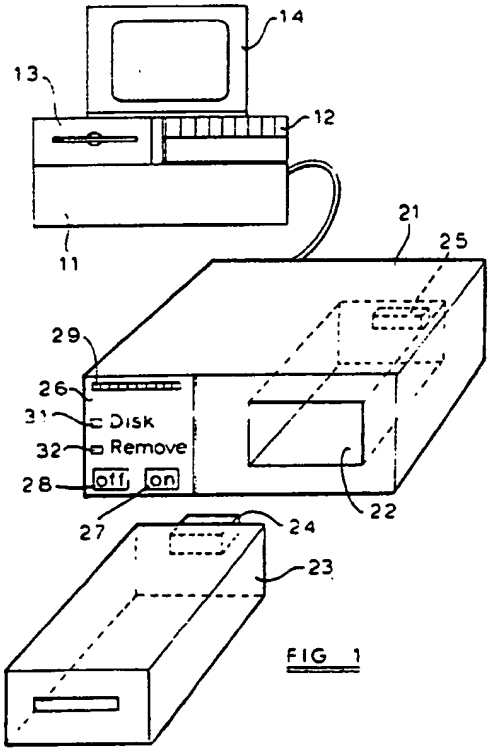

FIG 1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy

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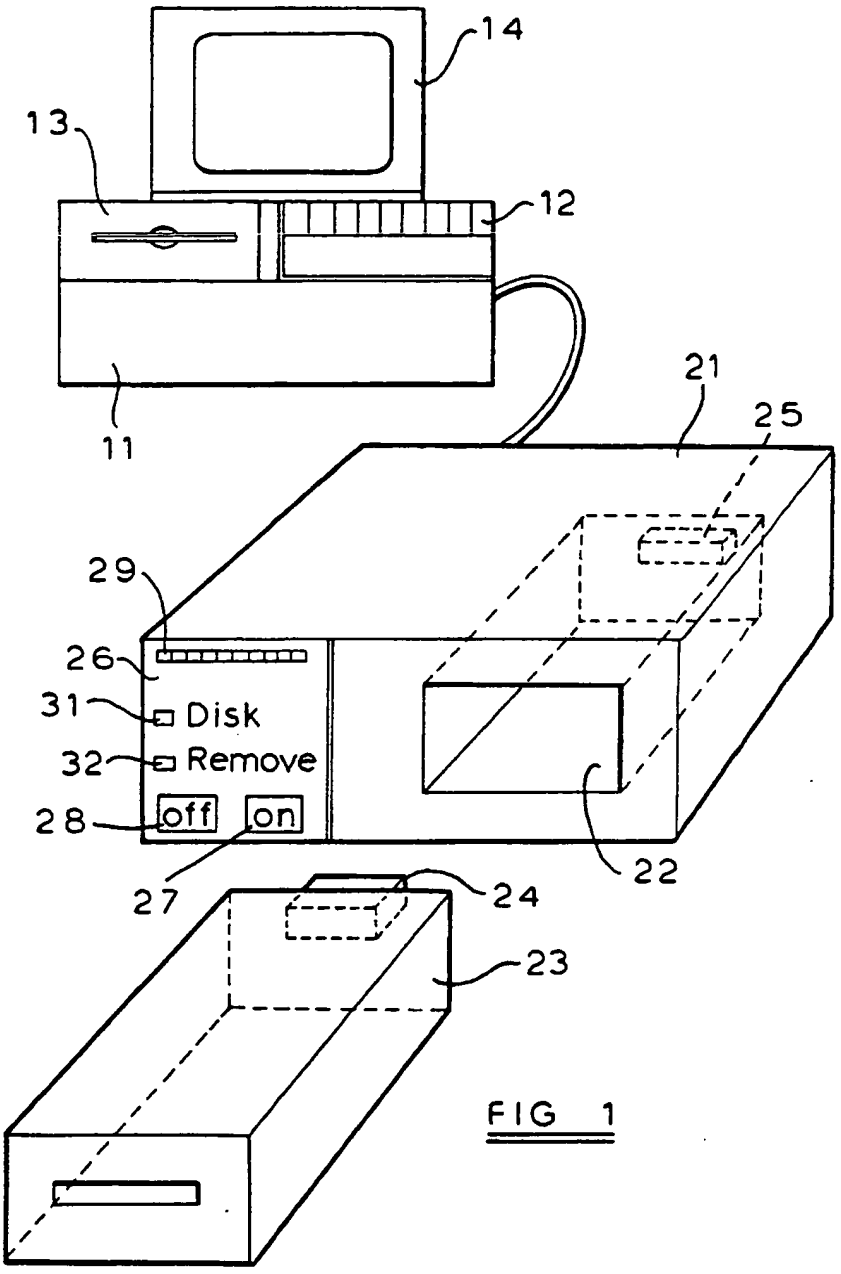

FIG 1

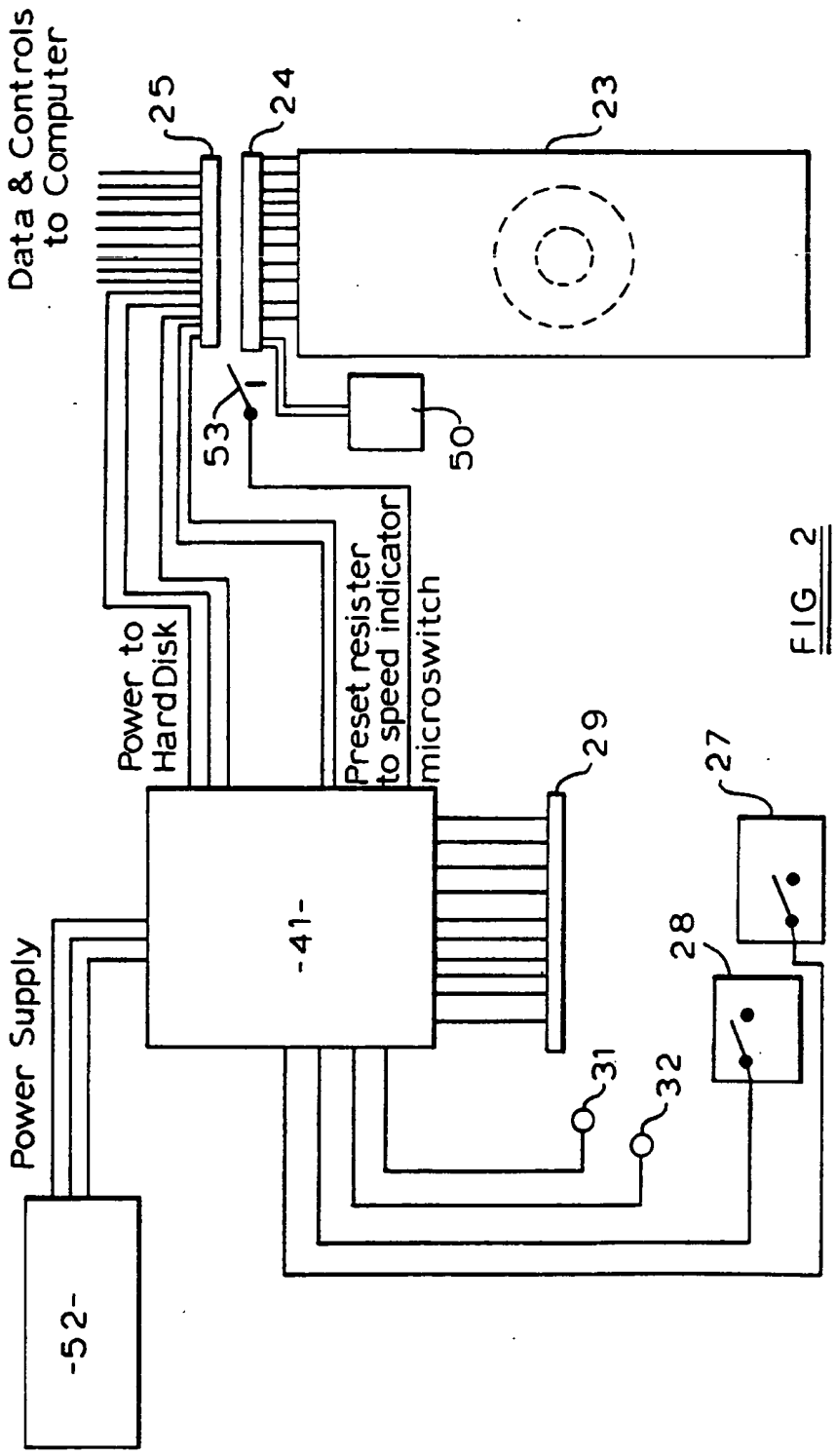
Data & Controls to Computer
25
24
23
53
1
50
Power to HardDisk
Preset resister to speed indicator
microswitch
29
27
28
-41-
31
32
Power Supply
-52-

FIG 2

AUXILIARY COMPUTER DRIVE ARRANGEMENT

The invention relates to an auxiliary computer drive arrangement for use in computers.

A common drive arrangement for micro computers is to supplement the internal computer memory of perhaps 640Kb with a floppy disk drive of typically 360Kb and a hard disk drive of perhaps 20Mb or 40Mb. The hard disk drive is normally an integral part of or at least permanently installed in the computer base unit. An assembly known as a hard disk drive incorporates not only the disk itself but also a motor for driving the disk and read/write heads. Because the disk itself is fragile and because of the intricacy of its installation, the disk itself is not removable from the disk drive.

In contrast a floppy disk itself is readily removable from its drive. Feeding of successive floppy disks into the floppy disk drive is the main way of communicating substantial volumes of data to and from a micro computer. Because of the difference in storage capacity between the typical 360Kb floppy disk and the 20Mb or 40Mb hard disk, in some situations it is necessary to feed some dozens of floppy disks, one at a time, into the floppy disk drive to transfer information to or from the computer. This is a

tedious and time consuming process.

In order to be able to bring several Mb of data to a computer, operate on this data and remove it from the computer with complete security against access by others to the data it is necessary with the conventional installation to copy the information to hard disk from several floppy disks, carry out the required functions, copy the modified data back to the floppy disks and then delete it from the hard disk. Even this practice may not be entirely secure because the normal delete process cuts off accessability to the data rather than destroying it entirely.

It has already been proposed to overcome these difficulties by providing a computer with a removable hard disk drive. The package removed is the complete drive including the disk itself, a drive motor, read/write heads and a casing for this assembly. A difficulty with making disk drives removable is their fragility, particularly while the disk is running. The problem is compounded by the fact that the disk continues to run for a significant period of time (perhaps 5 to 25 seconds) after power to it has been switched off. Any attempt to remove the disk drive immediately after switching off could cause severe damage.

An objective of the present invention is to provide an

arrangement in which this problem is reduced or eliminated.

In accordance with the present invention there is provided a disk drive assembly for a computer comprising a housing incorporating an aperture for receipt of a hard disk drive unit, a hard disk drive unit incorporating a casing, a hard disk itself and read/write heads for the disk, the casing being readily insertable into and removable from the aperture without disturbing or removing parts of the housing or other elements of the computer, interengaging connectors associated with the casing and the aperture to automatically connect up the disk drive unit to the computer on installation within the aperture and a control system for the hard disk drive including means for switching the drive on and off and a disk speed display responsive to switching off the drive and such as to display an indication of reducing speed of the disk until the disk comes to rest.

The indication of reducing speed may be coupled to a speed sensor and arranged to respond to actual speed reduction but a simplified alternative is preferred. With this alternative, a typical safe period for a disk to come to rest is derived for the particular type of disk used and a timer such as an R-C circuit is set for this period. The timer then drives the speed indicator. If timing is by voltage decay in an R-C circuit the gradual voltage decay

can be used to drive the display.

By displaying an indication of reducing speed an operator of the computer can see that something positive is happening while speed is being reduced and is thus reminded not to remove the hard disk drive unit immediately after switching off. In contrast, simple stop/run indicators can be misinterpreted; for example the indicator could have been quiescent for say 15 seconds while the disk is still running after switching off and at that time an operator could remove the disk drive while it is still running. A mechanical interlock to prevent removal while the disk is running is not satisfactory because an impatient operator is likely to jerk the disk drive while attempting to remove it when it is still running, thus risking damage.

Preferably the speed indicator is supplemented by a further indicator showing that the disk has come to rest and that it is safe to remove it.

Preferably the speed indicator is a row of signal lamps which are extinguished one by one from one end of the row as speed reduces. Other forms of speed indicator such as a dial or a digital display may be used in place of the indicator lamps. The fundamental requirement is that continuous or frequent changes in the display should occur

to indicate that something is happening.

The housing is preferably separate from the computer base unit and is preferably dedicated to receipt, control and operation of the disk drive unit. Alternatively, it could be incorporated as part of the base unit of the computer.

An embodiment of the invention will now described with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic representation of a complete computer installation incorporating the invention; and

Figure 2 is a block diagram showing further details of the invention.

Figure 1 shows a complete installation incorporating the invention. A standard micro computer comprises a base unit 11 incorporating all the usual computer elements including a hard disk drive 12, a floppy disk drive 13 and a console 14.

An auxilliary hard disk drive assembly incorporates a housing 21 with an aperture 22 for receiving a hard disk drive unit 23. The unit 23 is shown removed from the housing 22, but it can be slid in and out along guides which position it accurately within the housing such that a

connector 24 at the rear of the disk drive unit engages with and forms electrical connections to a corresponding connector 25 at the back of the aperture 22.

The complete disk drive unit 23 may be any conventional form of disk drive incorporated in a casing to provide some physical protection against mishandling and also to facilitate location of the unit within the aperture 22. The casing also carries the electrical connector 24. Because any conventional disk drive may be employed, it is not described in detail.

The housing 21 also includes the circuitry to control operation of the hard disk and allow communication with the computer itself. Further information on this circuitry will be described subsequently with reference to Figure 2.

The front face of the housing 21 also incorporates an indicator panel 26. The indicator panel carries an "ON" button 27 and an "OFF" button 28 which are connected as will be described subsequently to switch the auxiliary hard disk on and off. Panel 26 also incorporates a speed indicator 29. The speed indicator is in the form of a row of ten LED lamps. These are arranged to respond to the speed of rotation of the disk such that all ten are lit when the disk is running at normal speed and the lamps are extinguished

one by one from one end as speed reduces. The last lamp should preferably be extinguished as the disk comes to rest, but may in fact remain illuminated for a few seconds more. These lamps may for example be coloured red. A further warning lamp 31 also constituted by a red LED is labelled 'DISK'. This lamp is active (i.e. flashing) when the disk is being accessed for reading or writing data. A further green LED 32 with a message such as "REMOVE" becomes illuminated when the disk comes to rest, indicating that it is safe to remove it. The speed indicator 29 should be disabled when the disk is running normally in which case it is enabled immediately the disk drive is switched off to show its gradually reducing speed. When an operator has switched off the drive, he sees the individual LEDs of the speed indicator extinguishing one by one to indicate that something positive is happening. After a delay of some seconds, all the speed indicator lamps are extinguished, and the REMOVE lamp 32 becomes illuminated. Because of the evident near continuous activity as the speed indicator LEDs become extinguished one at a time at intervals no greater than about two seconds, there is little risk of an operator removing the disk while it is still rotating and thus susceptible to damage.

Figure 2 shows further details of the circuitry employed within the housing 21 for operation of the disk drive. A

control unit 41 is arranged to receive ON and OFF signals from the switches 27 and 28 and a speed signal from the hard disk itself. The control unit also provides illumination signals to the speed indicator 29 and to the disk and remove lamps 31 and 32 and an on/off signal to the hard disk. It also controls data transfer between the hard disk and the computer. A power supply 52 is also incorporated within the housing 21.

A micro switch 53 is arranged to be operated by insertion of the disk as an indication that the disk has been inserted correctly and that terminals 24 and 25 have been interconnected. On signalling this event to the control unit 14, power supply and other interconnections between the control unit and connector 25 are activated. In this way, there are no live open ended connectors when no disk is present.

The disk drive unit 23 incorporates as an integral part a speed circuit 50. In this example, the speed circuit 50 is in the form of an R-C circuit. The capacitance is charged to a supply voltage on insertion of the disk unit and switching on the drive. When the drive is switched off the supply is cut off and the voltage decays at a rate dependant on the capacitance and resitance values. These are chosen so that the period for decay down to a threshold voltage

level is a little longer than the expected time taken for the disk to come to rest. The actual time taken for a disk to come to rest varies within reasonably narrow limits for a particular specification of disk. It is possible by experimenting with a series of disks of the same type to derive a period within which all disks of that type can be expected to have come to rest. Such a period is only a short time greater than the typical period within which a disk of this kine will come to rest. For experimental installations, a variable resister may be employed but for production purposes a fixed resistance should be acceptable.

In operation, when the disk drive is switched off, the control unit 41 turns on all the LEDs 29. The gradual decay in the voltage from the speed circuit 50 is used via the control unit to turn off these LEDs one at a time. By the time the last LED is extinguished, the disk should have come to rest. An operator should not remove the disk unit 23 until all the LEDs 29 have been extinguished so the hard disk should not be moved while it is still running.

In an alternative, the speed circuit 50 may be replaced by a circuit which is coupled to the motor drive for the disk and responds to the actual speed of the disk.

CLAIMS

1. A disk drive assembly for a computer comprising a housing incorporating an aperture for receipt of a hard disk drive unit, a hard disk drive unit incorporating a casing, a hard disk itself and read/write heads for the disk, the casing being readily insertable into and removable from the aperture without disturbing or removing parts of the housing or other elements of the computer, interengaging connectors associated with the casing and the aperture to automatically connect up the disk drive unit to the computer on installation within the aperture and a control system for the hard disk drive including means for switching the drive on and off and a disk speed display responsive to switching off the drive and such as to display an indication of reducing speed of the disk until the disk comes to rest.

2. A disk drive assembly as claimed in Claim 1 in which the disk speed delay is driven by a timer which has been preset to a period within which the disk should have come to rest.

3. A disk drive assembly as claimed in Claim 2 in which the timer is an R-C circuit, the gradual decay in its voltage being used to drive the display.

4. A disk drive assembly as claimed in any one of the preceding claims in which the speed indicator is supplemented by a further indicator showing that the disk has come to rest.

5. A disk drive assembly as claimed in any one of the preceding claims in which the speed indicator is a row of signal lamps which are extinguished one by one from one end of the row as speed reduces.

6. A disk drive assembly as claimed in any one of the preceding claims in which the housing is separate from a computer base unit and is dedicated to receipt, control and operation of the disk drive unit.

7. A disk drive assembly for a computer substantially as described with reference to and as illustrated by the accompanying drawings.

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